United States Patent

Mortensen

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[54] DOOR ASSEMBLY

[72] Inventor: **Peder Mortensen**, Skovbrynet 1, Bagsvard, Denmark

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[52] **U.S. Cl.** .....**220/40 R**, 220/46 P
[51] **Int. Cl.**.....**B65d 41/06**
[58] **Field of Search** .....220/40 R, 46 P, 46 R; 292/256, 292/256.6; 285/362, 377

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Primary Examiner—Joseph R. Leclair
Assistant Examiner—James R. Garrett
Attorney—Chittick, Pfund, Birch, Samuels & Gauthier

[57] **ABSTRACT**

A door construction for an opening in a pressure vessel, including an annular collar into which a door member is seated when in the closed position. The door member carries a rotatable locking ring having radially disposed circumferentially spaced lugs which cooperate with lugs on the collar to lock the door in the closed position.

5 Claims, 5 Drawing Figures

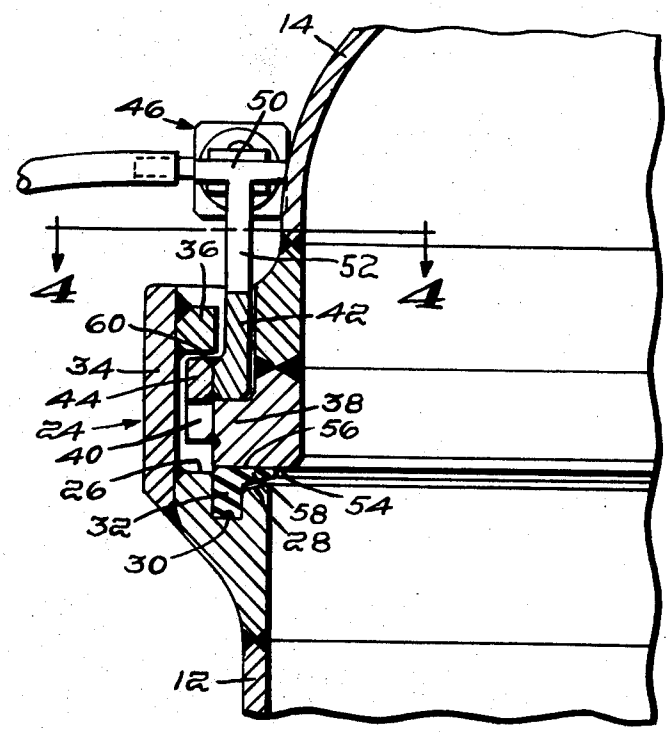

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Fig. 1.

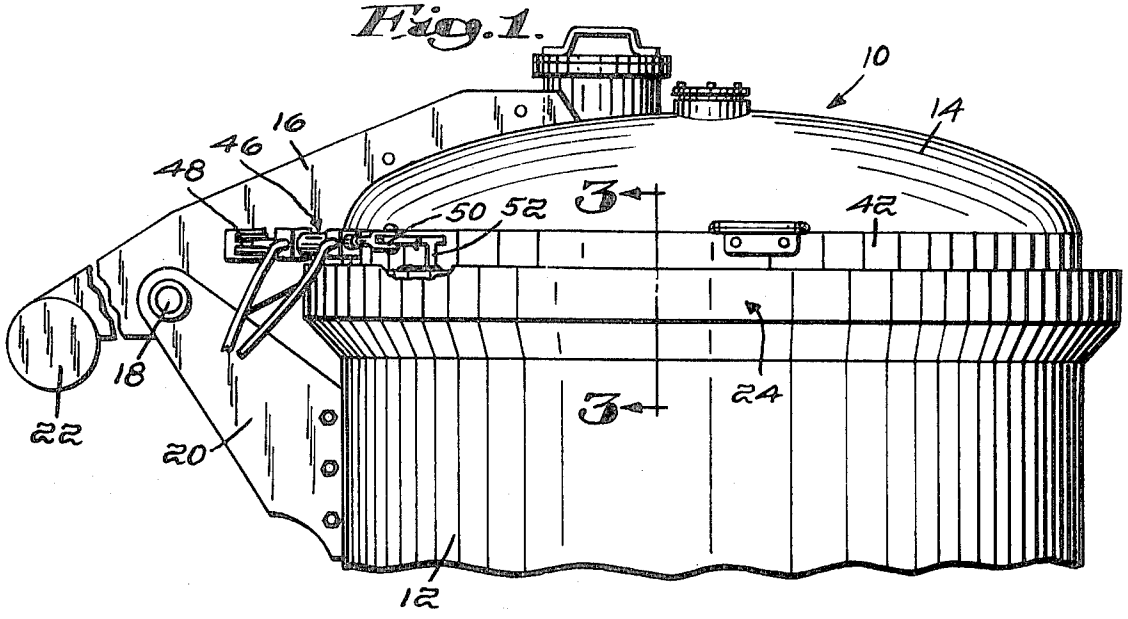
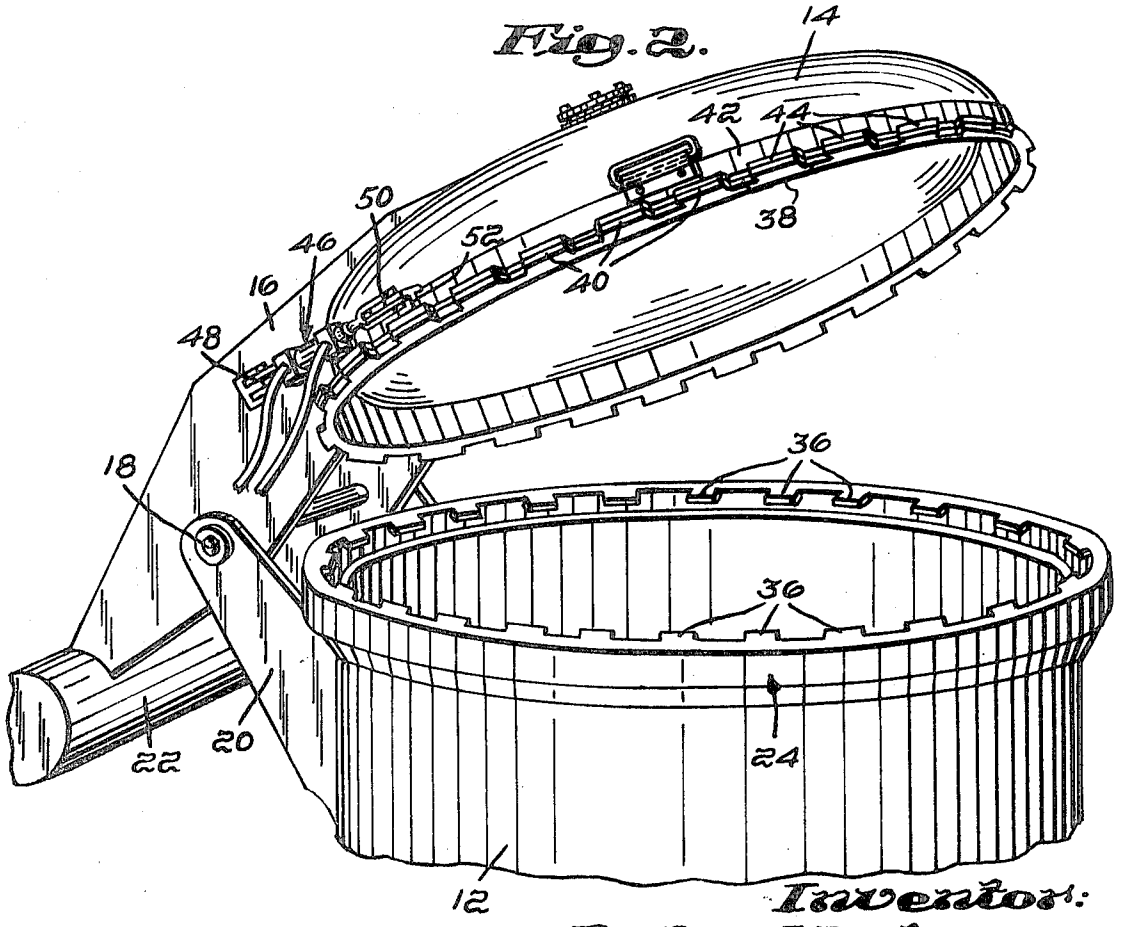


Fig. 2.



Inventor:
Peder Mortensen,
by Cuttick, Flynd, Birch, Samuels & Gauthier
Attorneys

Fig. 3.

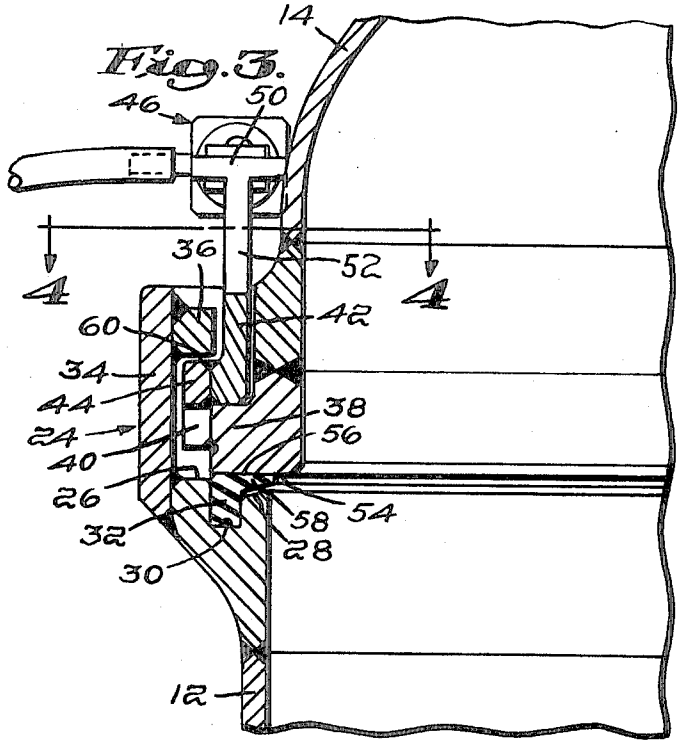


Fig. 4.

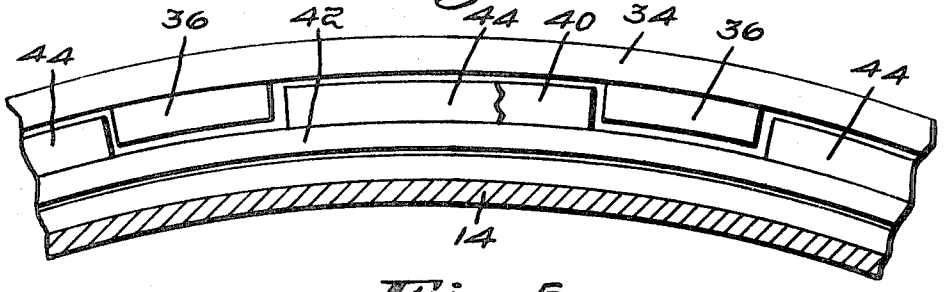
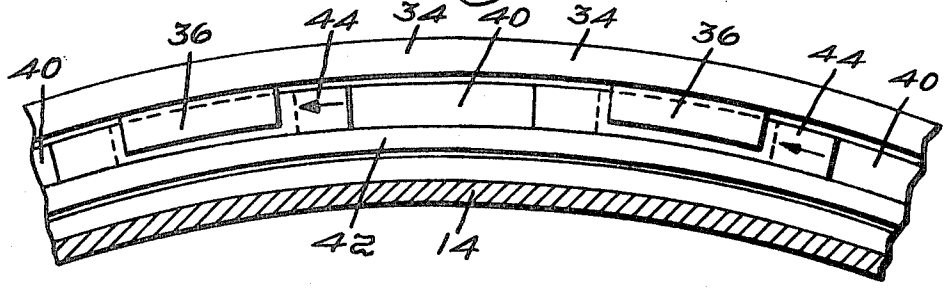


Fig. 5.



Inventor:
Peder Mortensen,
by Cuttick, Pfund, Birch, Samuels & Gauthier
Attorneys

DOOR ASSEMBLY

DESCRIPTION OF THE INVENTION

This invention relates generally to door constructions for pressure vessels, and is particularly concerned with an improved fast-acting means for locking a door member in the closed position.

The known prior art door constructions which are already in use for the most part rely on cooperating cam surfaces on locking rings, split collars, etc. to push a door member into sealing engagement with a resilient seal surrounding the opening in the vessel wall. Considerable force is required to rotate or otherwise position the locking cams. Moreover, the cam surfaces must necessarily be accurately machined in order to produce the desired even sealing force around the entire circumference of the door. These factors each tend to increase the overall cost of such prior art door assemblies.

It is accordingly a primary object of the present invention to obviate the aforementioned difficulties by locking the door member in the closed position without employing cooperating cam surfaces. To this end, the opening in a pressure vessel is surrounded by a collar which is provided with a plurality of circumferentially spaced inwardly extending radial lugs which cooperate with radial lugs on a rotatable locking ring carried by the door member to lock the door member in the closed position. The two sets of lugs remain spaced apart in two separate planes until such time as the interior of the vessel is pressurized. The vessel pressure has a tendency to push the door member outwardly, thus causing the lugs on the locking ring to abut the lugs on the surrounding collar, thus insuring that the door member remains securely locked in place. Since the lugs on the locking ring are spaced from the lugs on the collar when the ring is rotated to the locked position, only minimum force is required to rotate the ring. Furthermore, the machining costs are considerably reduced since cam surfaces are not employed in the instant arrangement.

These and other objectives and advantages of the present invention will become more apparent as the description proceeds with the aid of the accompanying drawings wherein:

FIG. 1 is a side elevation of a pressure vessel employing a door construction constructed in accordance with the present invention;

FIG. 2 is a perspective view of the apparatus shown in FIG. 1 with the door member in the open position;

FIG. 3 is a sectional view taken along lines 3—3 of FIG. 1;

FIG. 4 is a sectional view taken along line 4—4 of FIG. 3 with the locking ring in the "unlocked" position; and,

FIG. 5 is a view similar to FIG. 4 showing the locking ring rotated to the "locked" position.

Referring now to the drawings with initial attention to FIGS. 1 and 2, there is shown a pressure vessel generally indicated at 10 having a cylindrical wall 12, the upper end of which is closed by a door member 14. The door member is provided with a bracket 16 which is pivotally attached as at 18 to a mounting bracket 20 extending upwardly and angularly from the vessel wall 12. In order to facilitate opening and closing of the door member, bracket 16 is preferably provided at its distal end with a counterweight 22.

The locking agreement which comprises the essence of the present invention will now be described in more detail with additional reference to FIGS. 3 to 5. The cylindrical vessel wall 12 is provided at its upper end with a collar 24. The collar includes an annular somewhat horizontally disposed shelf defining stepped surfaces 26 and 28 separated by a groove 30 containing a flexible lip seal 32.

Collar 24 further includes a vertically extending wall section 34 which is provided with a plurality of circumferentially spaced "first" lug members 36 extending radially inwardly therefrom.

Door member 14 is provided with a peripheral lip 38 from which a plurality of circumferentially spaced "second" lug members 40 extend radially. The circumferential spacing of the second lug members 40 is such that they will pass between

the first lug members 36 on the wall section 34 of collar 24 when the door member 14 is moved between the open position as shown in FIG. 2 and in the closed position as shown in the remainder of the drawings.

Door member 14 carries a rotatable locking ring 42. The locking ring is also provided with a plurality of circumferentially spaced radially extending "third" lug members 44. The dimensions and circumferential spacing of lug members 44 is identical to that of the underlying lug members 40 on the door member 14. Thus, and as is best shown in FIG. 4, when the locking ring is rotated to the "unlocked" position, lugs 44 directly overlie lugs 40 with the result that both sets of lugs may pass between the inwardly disposed lugs 36 on collar member 24 when the door is opened and closed.

Rotation of the locking ring is accomplished by means of a double acting cylinder assembly 46, preferably pneumatically actuated, which is attached at one end as at 48 to bracket 16, and at the other end as at 50 to the upstanding leg 52 on the locking ring.

The door construction operates as follows: beginning with the condition shown in FIG. 2 with the door member 14 in the open position, it will be understood that cylinder assembly 46 has been actuated to rotatably adjust the locking ring 42 to the "unlocked" position as depicted in FIG. 4. The door member is then swung downwardly to the closed position to completely enclose the interior of pressure vessel 10. At this point, the lower face 54 (see FIG. 3) on the peripheral lip 38 of the door member will be in contact with the upper surface 56 of seal 32, the latter having an inwardly disposed lip section 58 overlying the lower stepped surface 28 on collar 24.

It is important to observe that at this point, the vertical spacing between the flexible seal surface 56 and the inwardly disposed lugs 36 is such that there exists a clearance 60 (see FIG. 3) between the underside of lugs 36 and the top side of lugs 44. This clearance enables the locking ring 42 to be rotated relative to door member 14 to the "locked" position shown in FIG. 5 with an absolute minimum effort. When in the "locked" position, lugs 44 underlie lugs 36, thus effectively preventing the door member from opening as the vessel 10 is pressurized.

As the interior pressure of the vessel increases, the door member 14 is pushed up slightly until the lugs 44 contact lugs 36 and the clearance 60 is dissipated. This slight upward movement of the door is compensated for by the resilient lip section 58 on resilient seal 32. The lip section 58 is actually forced upwardly under pressure along with the door member, thus insuring an uninterrupted continuous seal.

When the door member is to be opened, the above outlined procedure is simply reversed after the interior pressure of the vessel has been reduced to atmospheric pressure.

Having thus described a preferred embodiment of the invention, it will be apparent to those skilled in the art that minor modifications may be made without departing from the spirit and scope of the invention as claimed in the following claims.

I claim:

1. A door assembly for an opening in a pressure vessel comprising in combination: an annular collar surrounding said opening, said collar having circumferentially spaced first lug members extending radially inwardly therefrom toward said opening; a non-rotatable door member mounted on said vessel for movement between an open position allowing access into the interior of said vessel through said opening and a closed position closing said opening; circumferentially spaced second lug members extending radially outwardly from said door member; a locking ring circumferentially mounted about said door member for rotation between a locked an an unlocked position; circumferentially spaced third lug members extending radially outwardly form said locking ring, said third lug members being aligned vertically with said second lug members when said locking ring is in the unlocked position, said second and third lug members being suitably dimensioned and circumferentially spaced to pass between said first lug mem-

bers when said door member is moved between said open and closed positions, said second and third lug members lying in separate planes spaced beneath the plane of said first lug members when said door member is in the closed position prior to the interior of said vessel being pressurized, whereupon rotation of said locking ring to the locked position will result in said third lug members being corresponding rotated to positions partially underlying and spaced beneath said first lug members, and partially overlying and spaced above said second lug members.

2. The apparatus as claimed in claim 1 further characterized by said collar having an annular ledge spaced beneath said first lug members, and a flexible seal mounted on said ledge, said door member being in contact with said seal when in the closed position.

3. The apparatus as set forth in claim 2 further characterized by said annular ledge being made up of a first annular surface raised vertically above a radially inwardly disposed second annular surface, said first and second annular surfaces being separated by a groove in which is seated said flexible seal.

4. The apparatus as set forth in claim 3 further characterized by said flexible seal having a radially inwardly extending lip section overlying and spaced above said second annular section on said annular ledge.

5. The apparatus as set forth in claim 4 further characterized by the vertical spacing between said flexible seal and said first lugs being sufficient to accommodate rotation of said locking rings with said third lugs remaining spaced beneath said first lugs.

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